# Non-Destructive test (NDT) of weld metals

## 1.0 INTRODUCTION:

Non-destructive testing (NDT) encompasses all methods of detection of flaws or defects in a component or in a structure without changing or destroying their usefulness.

Fabrication technique such as welding require considerable skill so, it is inevitable that mistake will occur. Flaws will be incorporated in the material during welding and therefore post-fabrication testing will be essential to find out any such serious flaws that may impair the performance. NDT methods are also referred as NDE (Non-destructive examination).

NDT examines actual production pieces and reveals the presence of flaws which can be evaluated against accept/reject criteria. It is one of the major tools of quality control and is firmly entrenched in quality programs of industries such as aerospace, automotive, defense, pipe line, power generation, preventative maintenance, pulp & paper, refinery and shipbuilding.

Some NDT methods are relatively simple to apply but others require considerable skill to understand the technique for successful application. The major benefits those can be accrued from NDT/ NDE are-

- Establishment of fitness for purpose.
- Compliance with technical and statutory requirements.
- Safety of plant & structures.
- Avoidance of loss due to break down.
- Protection of structures through predictive maintenance.

## 2.0 VARIOUS NDT METHODS:

**2.1 Visual Method** – The general appearance of a weld surface can sometimes provide information about the weld quality and help to lead to immediate rejection before any more expensive testing is undertaken.

Visual inspection includes the measurement of various weld parameters such as, surface contour, undercut, overlap, incompletely filled grooves, misalignment, shrinkage grooves, incorrect grinding, burn through, fillet lengths, etc.

For local examination of a portion of weld that is directly visible in eye, a small hand-held lens along-with a pen torch is useful. “Borescope”, an optical system with its own light source allows the operator to see a magnified view of otherwise inaccessible surfaces and can be used to examine welds on the internal surfaces of tubes, etc. It operates by the application of fibre-optics system and can retrieve image over distances up to several meters. Borescope now are coupled with close-circuit TV (CCTV) camera, have been built for insertion into small tubes.

**2.2 Liquid Penetrant Test (LPT)** – Although it is the least complex of the methods but is highly sensitive to its application. In manual operation, it uses simple equipment to detect flaws (except under-bead flaws) open to the surface, and works on any material as long as it is not porous. Penetrants are petroleum or water-based liquids coloured by a dye. When these liquids are applied on the surface, the liquid seeps into the open voids. It is then removed from the surface and replaced by a white developer. The developer acts as a blotter, drawing out the penetrant trapped in voids. The penetrant stains the developer, indicating the presence and location of flaws.

**2.3 Magnetic Particle Test (MPT)** – MPT usually requires electrical equipment to generate magnetic field. Metals those are attracted by magnet can only be tested by MPT. The flaws do not have to be open to the surface but must be close to it. MPT works best for flaws which are elongated rather than round. An internal magnetic field is generated in the tested specimen. In locations where flaws (non-magnetic voids) exist, some of the field will leak off the specimen and bridge the voids through the air. Magnetic (iron) particles, dusted over the magnetized area, are attracted by the leakage or external fields. Their build-ups on the work-piece surface indicate the location of flaws.

**2.4 Radiographic Test (RT) –** Radioactive rays like X-ray, gamma rays are used to penetrate through the job surface for identification of defects. The specimen is placed between a source of radiation and a sheet of radiographic film. A flaw present anywhere within the specimen will absorb less radiation than the specimen itself. The flaw's presence and location will be indicated on the film by an area of higher or darker exposure.
The safety hazard is very important in RT tests.

**2.5 Ultrasonic Test (UT)** – The UT uses complex electronic equipment. Any material which transmits mechanical vibrations can be tested. UT detects both linear and non-linear flaws and permits three dimensional interpretations. Evaluation is often difficult. The UT instrument converts electrical pulses into mechanical vibrations or pulses. These pulses travel across the tested specimen and reflect from flaws because of their different acoustic nature. The returning reflected pulses are re-converted to electric energy and displayed as signals on a cathode ray tube (CRT). The position and size of these signals correspond to the position and size of the flaws.

**2.6 Eddy Current Test (ECT)** – ECT instruments are small and portable. The method is used only on electrically conductive materials, and only a small area can be inspected at a time. An energized electric coil induces a magnetic field into the tested specimen. The fluctuating magnetic field generates an electric eddy current. The presence of a flaw increases the resistance to the flow of eddy currents. This is indicated by a deflection on the instrument's voltmeter.